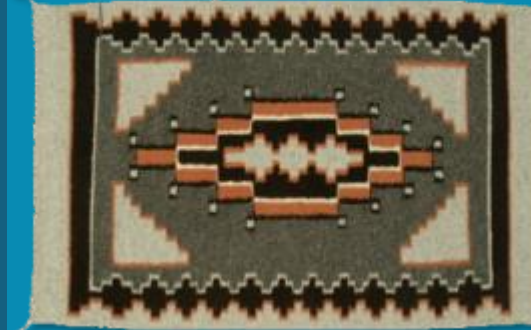




# Tribal Energy Equity and Resiliency



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Distinguished Member of Technical Staff  
Power Electronics & Energy Conversion Systems Dept.

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# DOE OFFICE OF ELECTRICITY ENERGY STORAGE PROGRAM



- The goal of the DOE Office of Electricity (OE) Energy Storage Program is to develop advanced energy storage technologies and systems in collaboration with industry, academia, and government institutions that will increase the reliability, performance, and sustainability of electricity generation and transmission in the electric grid and in standalone systems. The program also works with utilities, municipalities, states, and **tribes** to further wide deployment of storage facilities.
- This program is part of the Office of Electricity (OE) under the direction of Dr. Imre Gyuk.

*“Working with tribal entities to help them achieve energy sovereignty, is a valuable part of the DOE-OE Energy Storage Program. Storage plus renewables and microgrids are not only viable solutions for the Tribes; but are also the way of the future for the U.S. and the world.” – Dr. Imre Gyuk*

<http://www.sandia.gov/ess/>

# ENERGY STORAGE R&D AT SANDIA



## BATTERY MATERIALS

Large portfolio of R&D projects related to advanced materials, new battery chemistries, electrolyte materials, and membranes.



## CELL & MODULE LEVEL SAFETY

Evaluate safety and performance of electrical energy storage systems down to the module and cell level.



## POWER CONVERSION SYSTEMS

Research and development regarding reliability and performance of power electronics and power conversion systems.



## SYSTEMS ANALYSIS

Test laboratories evaluate and optimize performance of megawatt-hour class energy storage systems in grid-tied applications.



## DEMONSTRATION PROJECTS

Work with industry to develop, install, commission, and operate electrical energy storage systems.



## STRATEGIC OUTREACH

Maintain the ESS website and DOE Global Energy Storage Database, organize the annual Peer Review meeting, and host webinars and conferences.



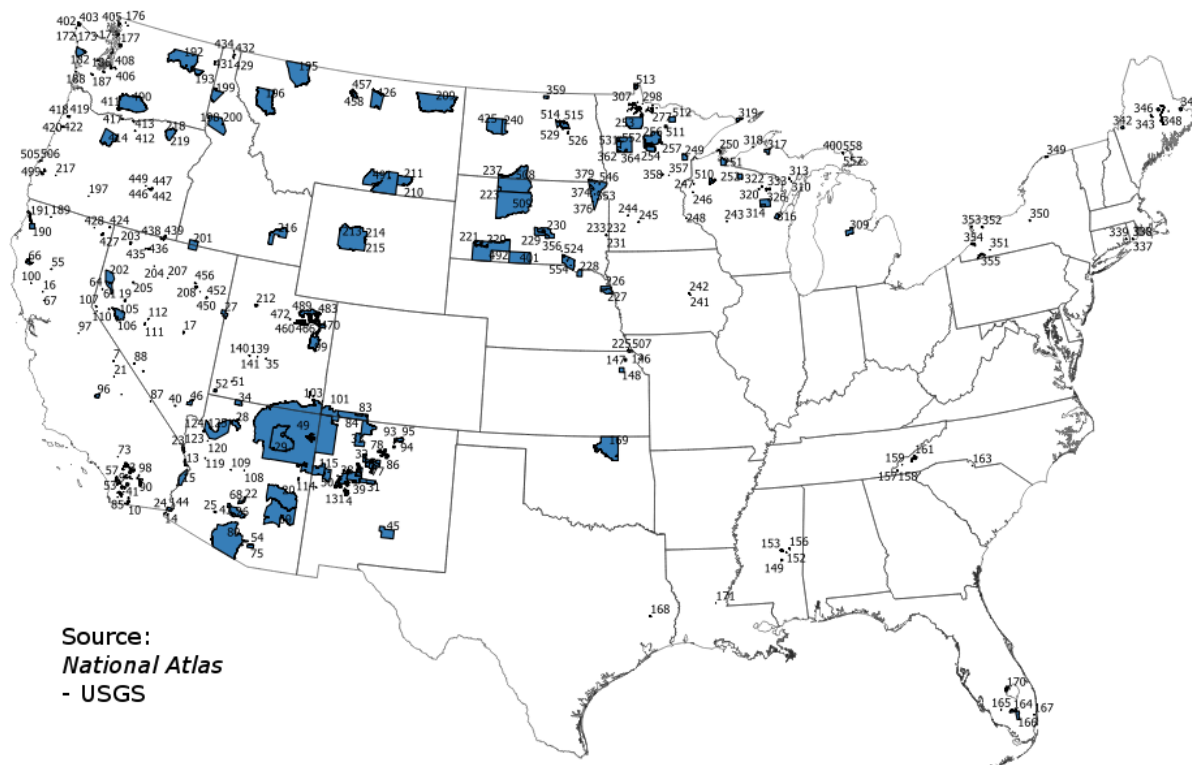
## GRID ANALYTICS

Analytical tools model electric grids and microgrids, perform system optimization, plan efficient utilization and optimization of DER on the grid, and understand ROI of energy storage.

Wide ranging R&D covering energy storage technologies with applications in the grid, transportation, and stationary storage



# 574 FEDERALLY RECOGNIZED TRIBES IN THE U.S.



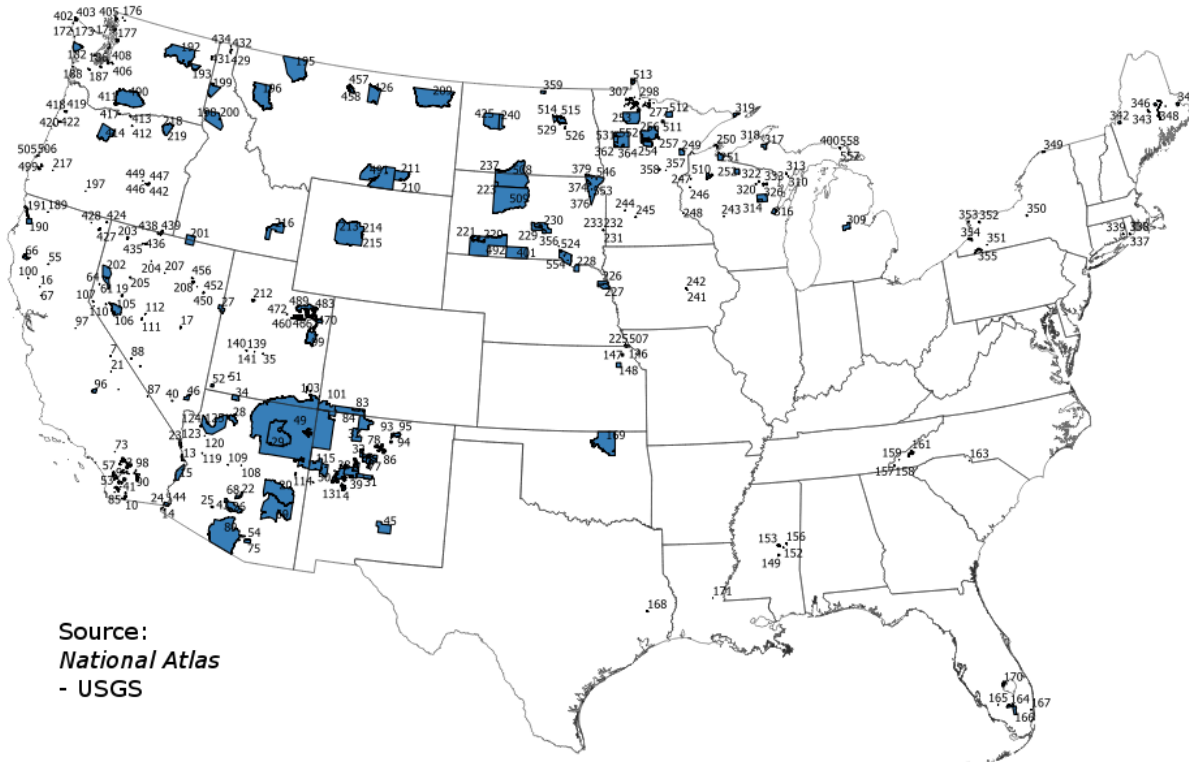
Source:  
National Atlas  
- USGS

- 326 Native American reservations in the US (most are in the 34 or lower 48 States)
- Known variously as Villages, Nations, Pueblos, Communities, Bands, Rancherias, etc.
- American Indian and Alaska Native or Native American terms may be used interchangeably as collective reference to tribal communities and peoples unless Tribal affiliation is specifically stated.
- There are also some state recognized tribes.
- Current population is **6.79 million (2.09%)** of the entire U.S. population – U.S. Census Bureau



- Alaska is divided into 13 regional Native Corporations (229 tribes)

# 574 FEDERALLY RECOGNIZED TRIBES IN THE U.S.

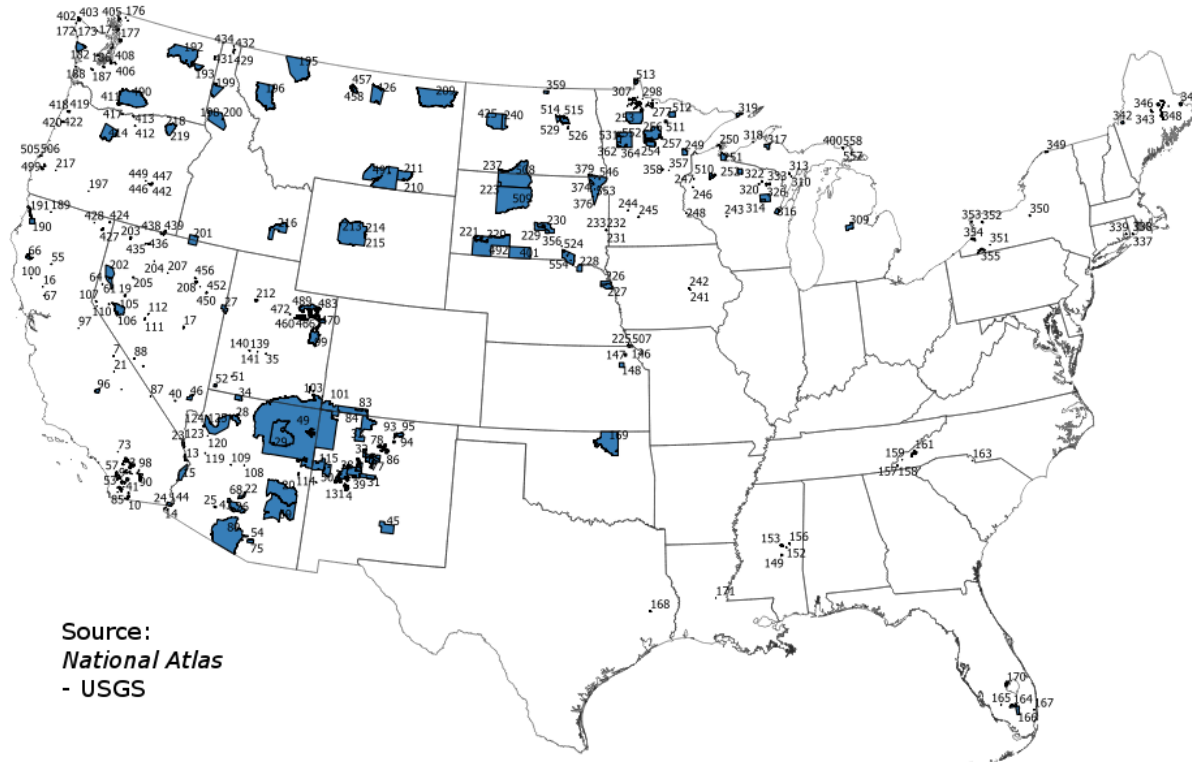


- **Tribal sovereignty:** tribes have their own government, traditions, culture, etc. and have a unique relationship with the federal and state governments.
- The tribal government exercise **single-point of authority** over their critical infrastructures and share common critical infrastructure modernization and protection concerns – **Energy Sovereignty**.



- Alaska is divided into 13 regional Native Corporations (229 tribes)

# RENEWABLE ENERGY POTENTIAL ON TRIBAL LANDS



Source:  
National Atlas  
- USGS

- Collective geographical area of all reservations is 56.2M acres, ~ size of the State of Idaho
- Range: 1.32 acres (Pit River Tribe CA) to 17M acres (Navajo Nation)
- Tribal lands comprise of about **5.8% of the land area** in the conterminous U.S. land
- Utility-scale renewable energy potential is **~6.5% of total national potential** – DOE Indian Energy

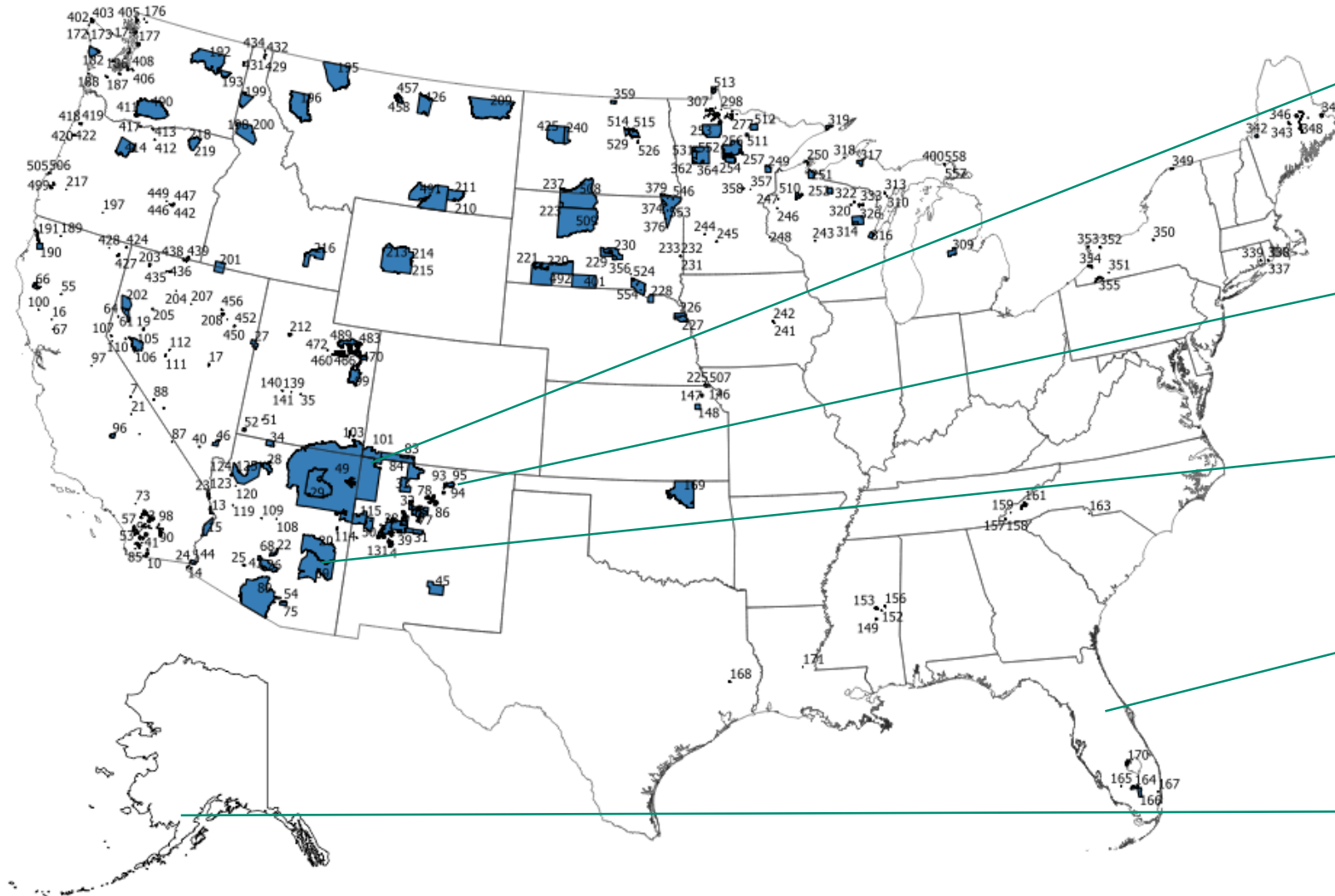


Source: NTUA





# 7 DOE OE ENERGY STORAGE TRIBAL ENERGY PROJECTS



Navajo Nation, Navajo Tribal Utility Authority (NTUA), Urban Electric Power, Georgia Tech Project

Picuris Pueblo Energy Storage Microgrid Project

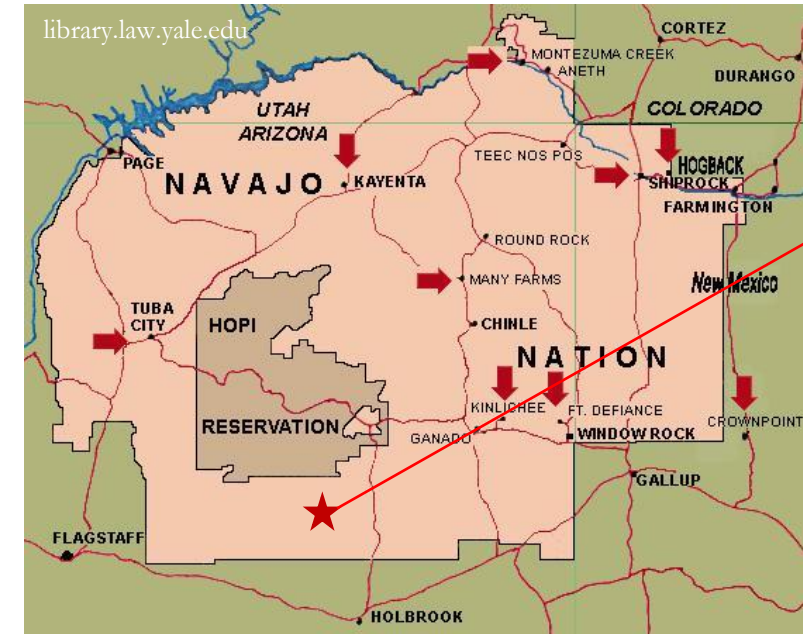
San Carlos Apache Tribe Energy Storage Microgrid Project

Seminole Tribe of Florida Energy Storage Microgrid Project

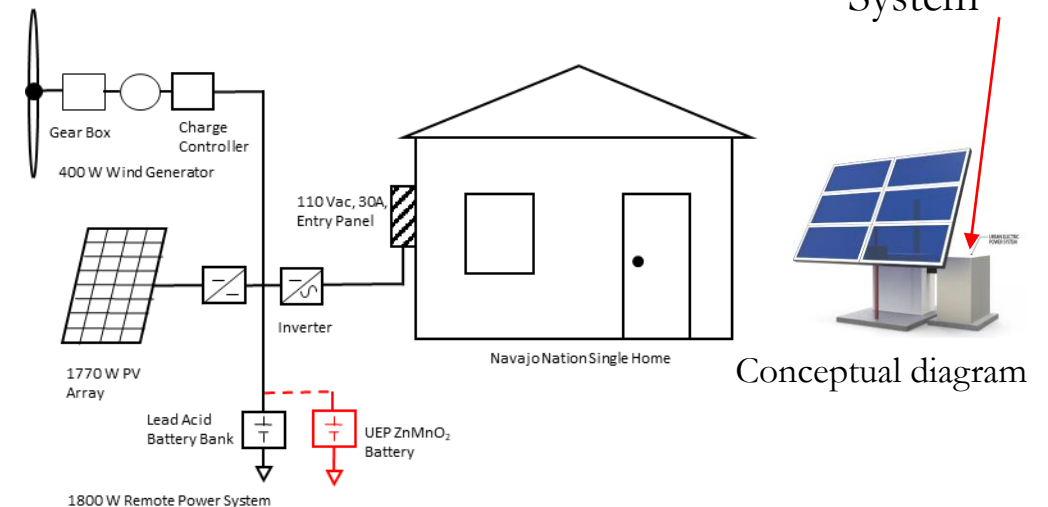
Alaskan Village of Levelock Energy Storage Microgrid Project

# ENERGY STORAGE BENEFITS TO THE NAVAJO NATION

- **Navajo Nation Tribe Facts:**
  - Tribal members: over 350,000 enrolled members
  - Area: 17,544,500 acres
  - Navajo Tribal Utility Authority (NTUA), est. 1959, provides electrical, water, and natural gas services
- **Problem Statement:**
  - Many residents are off-grid due to expense of installing electrical infrastructure to their homes
  - Traditional lead acid batteries have proven to work but come at a cost with replacing every 3-5 years
- **Approach:**
  - Procure batteries that are comparable in size to existing lead acid system of 13 kWh capacity
  - Install and monitor performance over a few years
  - Evaluate UEP Zn-MnO<sub>2</sub> technology compared to traditional lead acid batteries
- **Project Impact:**
  - Tribe will have access to alternative batteries that have better performance, is safer, and more environmentally friendly since UEP technology does not contain lead
  - Enhanced understanding of new battery technology and associated power electronic controls resulting in a more consistent delivery of off-grid power



UEP Batteries & Power Conversion System





# 9 RESILIENT “PLUG-N-PLAY” STORAGE FOR THE NAVAJO NATION

- **Problem Statement:**

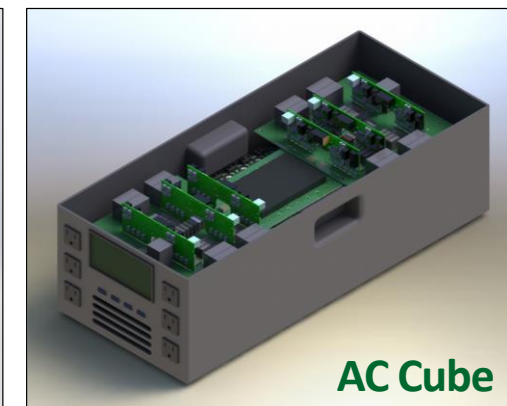
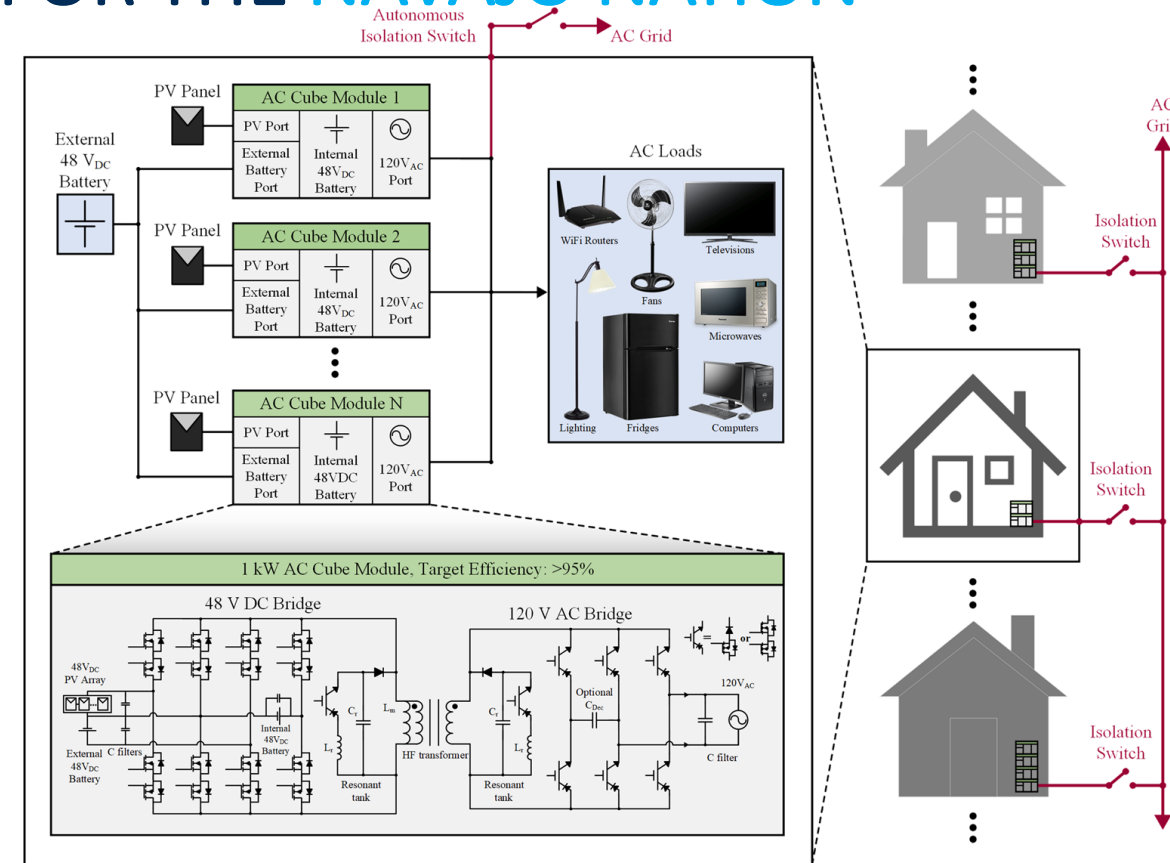
- Some Navajo Nation residents are deprived of electric power and there are few sustainable power solutions that are compact, flexible, capable of rapid deployment, and installed/operated/maintained without skilled technicians.

- **Approach:**

- Develop a high efficiency ultra low-cost, rapid deployment power electronic building block that enables a flexible remote power system architecture to fulfill the needs of the Navajo Nation community.

- **Project Impact:**

- Will provide an affordable flexible and reliable power solution for the Navajo Nation community that does not have access to electricity
- Solution will also be usable by communities that are facing grid resiliency issues due to hurricanes, wildfires, and other natural disasters



# ENERGY STORAGE BENEFITS TO PICURIS PUEBLO



- **Picuris Pueblo Facts:**

- Tribal members: ~300 enrolled members
- Small area: 256 acres
- Located in Sangre de Cristo Mountains, Taos County, Northern New Mexico

- **Problem Statement:**

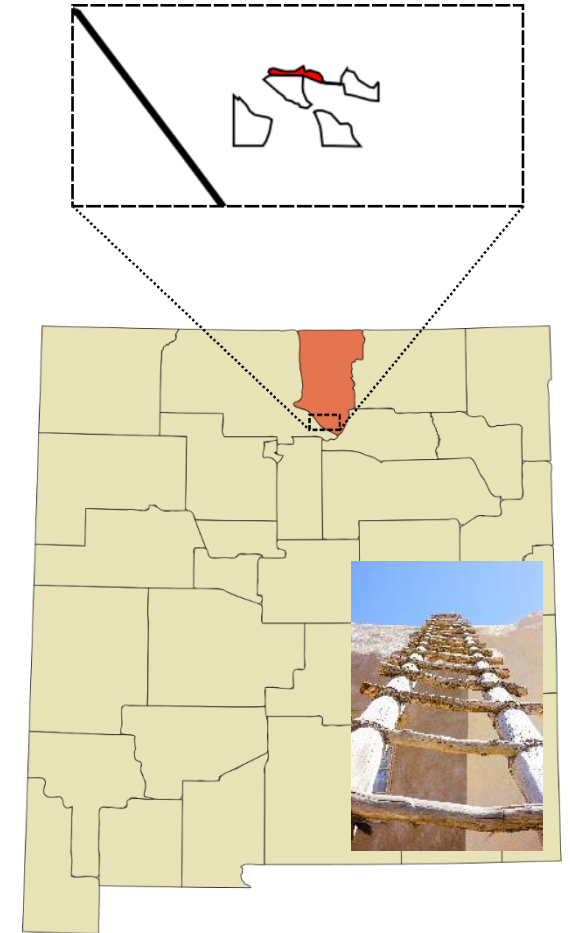
- High electricity rate
- 1 MW solar PV operational since Jan. 2018, funded through DoE grant and loan
- Tribe has a PPA to sell power to the local utility, Kit Carson Electric Co-op
- Revenue from PPA pays back loan and subsidizes tribal members' electric bills
- Funding secured for another project, a microgrid with 1 MW solar
  - Provide electricity directly into tribal buildings, homes and economic development buildings

- **Approach:**

- Evaluate alternative electrical service scenarios, including tribe's energy independence
- Evaluation of different solutions to couple large scale energy storage and solar
- Analysis of reduction of electricity costs with energy storage and solar power

- **Project Impact:**

- By deploying renewables plus storage, the tribe can secure greater tribal and economic sovereignty through energy independence and economic development



# ENERGY STORAGE BENEFITS TO SEMINOLE TRIBE OF FLORIDA

- **Seminole Tribe of Florida Facts:**

- Tribal members: 4,244 enrolled members
- Area: nearly 100,000 acres of land within the borders of FL
- 5 Seminole Indian Reservation in Florida as well as a tribal trust land in Fort Pierce
- Tribe provides services to members at the municipal and county level

- **Problem Statement:**

- Grid instability caused by weather-related events
  - 100 Outages per year
  - 20 hours per week using diesel generation
  - Tribe is developing energy resiliency capacity
  - Installing 973kW of PV and 3,300kWh of Energy Storage across 8 facilities

- **Approach**

- Assist in the RFP development and selection of vendor
- Reviewing system design, operation, and commissioning plan
- Evaluate solar plus storage over years of operation

- **Project Impact:**

- Enable the tribe to have a more resilience and cost effective solutions

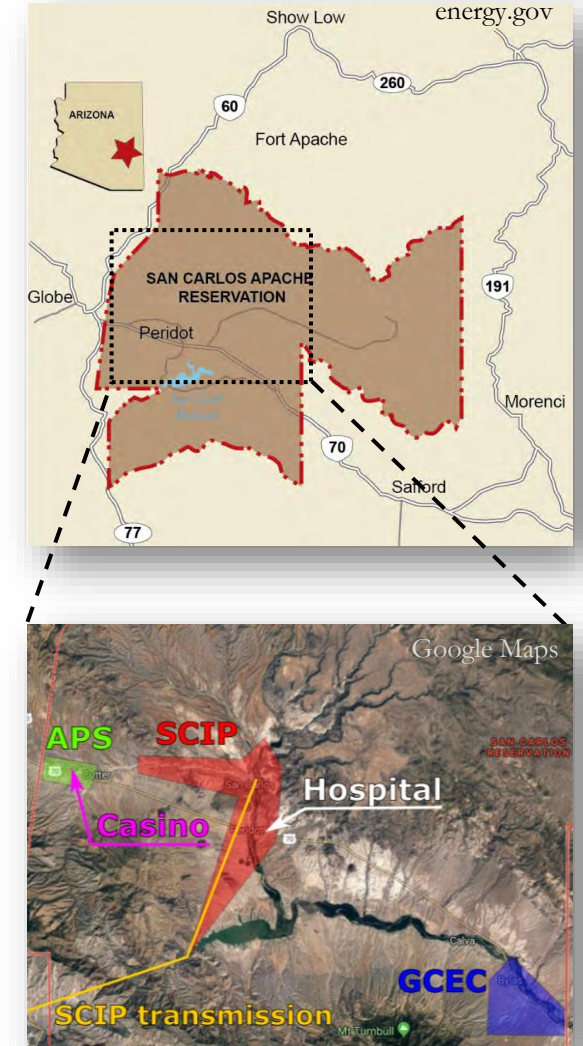


		125%	4 hours
	kW Max Demand (12 mo)	Minimum Battery Peak Power, kW	Minimum Battery Capacity, kWh
<b>Big Cypress</b>			
Big Cypress Frank Billie Field Office	138.9	180.0	320
Big Cypress Senior Center	83.9	110.0	150
Big Cypress Public Safety Complex	140.3	180.0	400
Big Cypress Health Clinic	201.9	260.0	640
<b>Brighton</b>			
Brighton Health Clinic	70.8	90.0	150
Brighton Administration Building	179.6	230.0	570
Brighton Public Safety Building	286.7	360.0	740
Brighton Veterans Building	140.2	180.0	350
	1242	1590	3320
	kW Demand	kW Batteries	kWh Batteries



# ENERGY STORAGE BENEFITS TO SAN CARLOS APACHE TRIBE

- **San Carlos Apache Tribe Facts:**
  - Tribal members: ~17,000
  - Area: 1.8 million acres (about the size of the State of Delaware)
  - Limited power generation and transmission assets – poor system reliability
- **Problem Statement:**
  - Tribal members report over 100 power outages per year
  - Some solar PV projects under way to decrease the tribe's energy dependency:
    - 2 - 3MW solar PV plant co-located with San Carlos Healthcare Hospital Community PV project
  - Tribe looking into deploying an energy storage system to decrease energy costs and improve reliability of critical loads



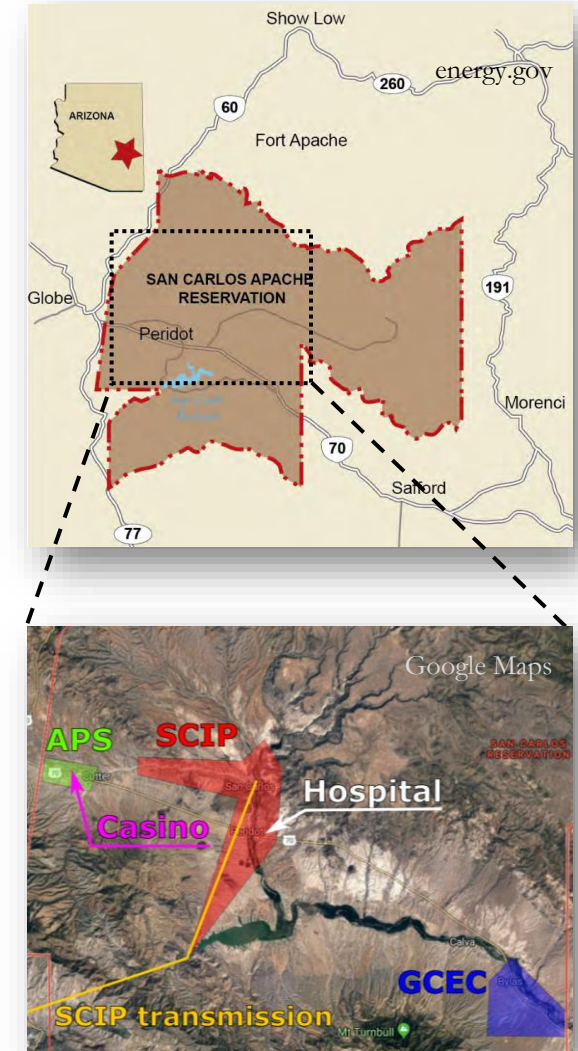
# ENERGY STORAGE BENEFITS TO SAN CARLOS APACHE TRIBE

- **Approach:**

- Estimate the cost savings for net energy metering customers using behind-the-meter energy storage systems.
- Analysis of cost savings obtainable given tariff structure (time of use, demand)
- Sizing of Energy Storage – system power (kW) and capacity (kWh)
- Evaluate potential to provide backup power to critical loads

- **Project Impact:**

- Analysis on local hospital has shown that financial benefit can be achieved by reducing power demand charges (peak consumption)
- By deploying renewables plus storage on tribal lands, the tribe can secure greater tribal and economic sovereignty through energy independence and economic development
- At current price estimates, analysis suggests ~200 kW/ 300 kWh battery would yield maximum NPV with ~ 7-year payback
- Potential to run fewer generators to avoid wet stacking/inefficient operation and maintain n-1 reliability with solar and 300kW battery



Trevizan, R. D., Nguyen, T. A., Attcity, S., & Headley, A. J. (n.d.). *Valuation of Behind-the-Meter Energy Storage in Hybrid Energy Systems*. Accepted for publication 2022 IEEE PES Innovative Smart Grid Technologies Conference

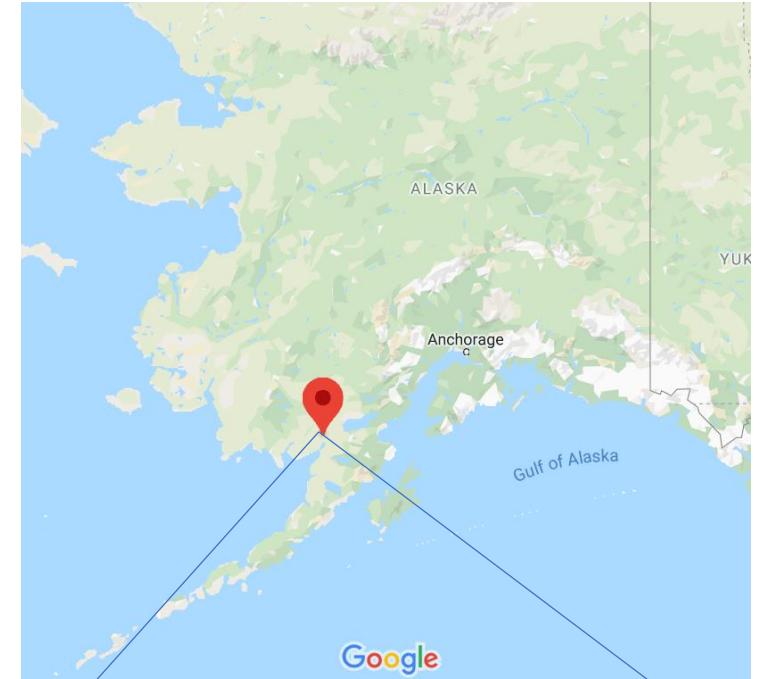
# ENERGY STORAGE BENEFITS TO LEVELOCK VILLAGE OF ALASKA

- **Levelock Village of Alaska Facts:**

- Tribal members: over 270 enrolled members (55 at the village, currently)
- Area: 7,744 acres
- Heart of Bristol Bay Region, home of the world's largest source of sockeye salmon

- **Problem Statement:**

- The tribe currently powered by three diesel generators (1-100kW and 2-67kW)
- Tribe is embarking on a remote area power system with energy storage due to high electricity cost (85c/kwh), high emissions from the generators, and high power outages per year.





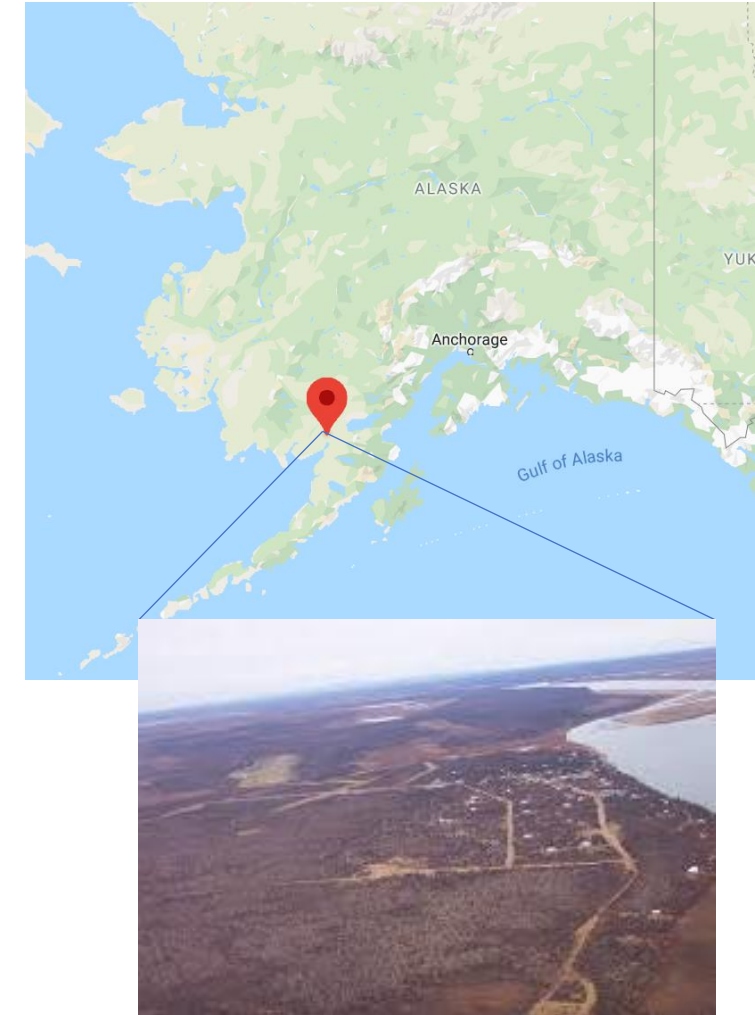
# ENERGY STORAGE BENEFITS TO LEVELOCK VILLAGE OF ALASKA

- **Approach:**

- Perform pre-microgrid baseline analysis – install meters on three diesel generators and analyze load profile, fuel usage, resilience, and cost of operation for approx. 5-6 months
- Estimate benefits of energy storage to the Village from multiple revenue streams, including: 1) reliability, 2) fuel cost savings, 3) reduction in operation and maintenance, and 4) extension of generator life

- **Project Impact:**

- Analysis suggests that major potential benefit of battery integration would be reliability improvements
  - Data logged over 163 days captured 69 power interruptions totaling 9.97 hrs. of interrupted service
  - 71 kW / 11 kWh would cover 95% of unserved load during outages (2020 est.) and greatly improve SAIDI/SAIFI metrics
- Batteries can also reduce run hours and wet stacking on existing generators with higher energy capacity



Trevizan, R. D., Headley, A. J., Geer, R., Atcity, S., & Gyuk, I. (2021). Integration of energy storage with diesel generation in remote communities. MRS Energy & Sustainability, 1-18.

# TRIBAL ENERGY STUDENTS



2019 Summer Interns

- DOE Indian Energy Summer Internship Program
- Minority Serving Institute Tribal Colleges & Universities Program



The Energy Storage Power Electronics Program is supported by Dr. Imre Gyuk and the Energy Storage Program in the DOE Office of Electricity.



# Questions?

Ahéhee' (Thank You!)